BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

1,091,693

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,091,693

Date of Application and filing Complete Specification: April 1, 1965. No. 13907/65

Application made in United States of America (No. 359048) on April 13, 1964.

Complete Specification Published: November 22, 1967.

Index at Acceptance:—**F2** E (1E, 2N2A2A, 2N2B1B1, 2N2B2, 2N2B3, 2N2B4, 2N2C1B, 2N2C2A, 2N2C2B, 2N2D2B, 2N2D6A); **B7** C (21B, 21F); **F1** C4A2; **H2** A (2K1, 2K8, 13D).

Int. Cl.:—F 16 d 55/40.

COMPLETE SPECIFICATION

Cooling Device for a Wheel and Disc Brake Assembly

We, THE BENDIX CORPORATION, a corporation organised and existing under the laws of the State of Delaware, United States of America, of Fisher Buildings, Detroit, Michigan, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a forced air cooled disc brake.

Before an airplane may safely take off, its brakes must be cooled down to a predetermined temperature to be capable of stopping the airplane in case of a rejected take off. This means that after an airplane has landed, a certain period must elapse for its brakes to cool down to the predetermined temperature before it may take off again. Therefore, it is most advantageous for the brakes to be cooled as quickly as possible.

Accordingly, it is an object of this invention to provide means for cooling the brakes of any heavy duty vehicle in a minimum period of time.

According to the invention there is provided a wheel and disc brake assembly for heavy duty service, e.g. for aircraft, comprising a plurality of stator members slidably mounted in an axial direction on a torque tube secured through a flange portion to the non-rotating axle of said wheel and defining an annular cavity with said axle, a plurality of rotor members alternating with said stator members and axially slidably mounted on said wheel, and actuating means adapted to squeeze said members together for braking of said wheel, said assembly further including a cooling device located in said annular cavity and adapted to supply air under pressure radially outwardly through openings provided in said torque tube to said stator and rotor members for cooling down the same regardless of the rotation of the wheel.

The invention will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 is a section view of one-half of a symmetrical wheel and brake assembly illustrating one embodiment of the invention; and

Figure 2 is a view similar to Figure 1 illustrating a second embodiment of the invention.

Referring to Figure 1, there is illustrated a wheel and brake assembly comprising a wheel 10 rotatably mounted on a stationary axle 12 and a stationary brake carrier member 14 which is rotatably mounted on the axle 12. The carrier member 14 is restrained by a torque reaction link on a well known bogey beam arrangement (not shown). However, the carrier member 14 may be restrained by a direct bolt connection to the axle. For practical purposes, the carrier member may be considered stationary during braking and should be considered as a stationary member hereinafter. The construction for rotatably mounting the wheel 10 to axle 12 and fixing the stationary carrier 14 to the axle 12 is well known and a description thereof is not deemed to be necessary. The carrier member 14 comprises an annular sleeve 16 surrounding the axle 12 and an annular flanged portion 18 extending in a direction outwardly away from and generally perpendicular to the axle 12. The flange 18 contains a plurality of fluid cylinders 20 each of which has a protective sleeve 22 threadedly secured thereto in which a piston 24 is slidably received. A block of insulating material 30 is secured to the head end of

the piston by a threaded pin 32 for protecting the hydraulic brake fluid from the heat generated during braking. The wheel 10 comprises two sections fastened together by a plurality of bolts 34. The hub portion 36 and the rim portion 38 of the wheel are interconnected by a plurality of spokes 40 defining therebetween a plurality of windows through which air may pass for cooling. A torque tube 42 comprising a sleeve 44 and an annular backing plate flange 46 extending away from and generally perpendicular to the axle 12 is fixedly secured to the carrier member 14 by a plurality of circumferentially spaced bolt and nut assemblies 48.

The torque tube 42 has a plurality of axially extending splines 49 which are respectively received in one of a plurality of slots 50 located on a respective one of a plurality of stator members 52 for allowing axial sliding of the stator members 52 relative to the torque tube member 42. Each stator member 52 has a plurality of friction pads 54 located in cups 56 secured to the stator member 52 by fasteners 55. The radial inner surface 58 of the wheel rim 38 has a plurality of splines (not shown) which are received in a respective one of a plurality of slots (not shown) located on a plurality of rotor members 60 to allow axial sliding of the rotor members relative to the wheel 10 and the torque tube 42. An annular rotatable impeller 62 is located in the cavity formed by the sleeve 44 and of the torque tube 42 and the sleeve 16 of the carrier member 14. An inverted squirrel cage motor is provided for rotating the impeller. A backbone 63 is secured to the carrier sleeve 16 by a snap ring 64 and is prevented from rotating by a keyed connection 65. An annular bearing race 66 is pressed onto the backbone 63 and a bearing race 67 is clamped to the impeller by a ring 68 secured to the impeller. A plurality of ball bearing 69 are located between the races permitting rotation of the impeller relative to the carrier 14. The ring 68 also acts as a seal for the bearing assembly. The squirrel cage motor comprises a plurality of circumferentially spaced stator poles 71, pressed on the backbone 63, windings 73 fixed to each stator pole, and a plurality of circumferentially spaced rotor bars 81 clamped to the impeller by a flange 77 secured to the impeller. A spacer 79 is provided between the bearing race 66 and the stator poles 71 for locating purposes. The impeller 62 has mixed flow characteristics for converting axial air flow to centrifugal air flow. A plurality of openings 70 are provided in the torque tube 42 and are aligned with the impeller openings for receiving the forced air therethrough. Well known differential pressure annular seals 72 are provided on the impeller which are at a clearance of approximately .005 inch from the radially inner surface 74 of the torque tube 42. A heat shield 75 is provided between the inner surface 58 of the wheel rim 38 and the radial outer edges of the rotor and stator members to protect the rim from heat generated during brake application. An annular shield 82 is attached to the stator member 52 closed to the piston 24 by any well known fastening means (not shown) and in combination with the heat shield 75 defines a path for the hot air thus protceting the fluid in the hydraulic cylinder 20 from the hot air being discharged.

In operation, upon brake application, hydraulic pressure forces the piston 24 outwardly from the cylinder housing 20 to effect axial movement of the stator members 52 and the rotor members 60 thereby squeezing them together to effect braking of the wheel 10. The squirrel cage motor may be actuated to rotate the impeller 62 and cause air to be sucked in through the windows between spokes 40 and then converted to radial flow between the rotor members 60 and stator members 52, past the area between the heat shield 75 and the radial outer edges of the rotor and stator members and then between the shields 75 and 82 to outside the wheel. A plurality of baffle flanges 76, each of which extends in a circumferential direction between a respective pair of splines on the wheel rim, is attached to the heat shield 75 and an annular plate 78 terminating in an annular baffle flange 80 is attached to the torque tube 42. The baffle flange 76 and the baffle flange 80 co-act to prevent hot air from passing back toward the windows and then recirculated through the annular impeller.

With reference to Figure 2, those elements which are the same as the previous embodiment are given the same reference numerals with a small "a" affixed thereto. An annular perforated shield 102 is inserted between the annular sleeve 44a of the torque tube and the annular sleeve 16a of the carrier member 14a. A plurality of circumferentially spaced air inlet tubes 104 extend into the cavity defined by the flange 18a of the carrier member 14a, the sleeve 16a of the carrier member 14a, the shield 102 and the sleeve 44a of the torque tube 42a, for the purpose of delivering air under pressure into the cavity, through the opening 70a in a torque tube sleeve, through the spaces between the rotor elements 60a and the stator members 52a and to outside the wheel through a path defined by the shield 82a and the heat shield 75a. A tube 106 conveys air under pressure to the inlet tube 104 from any source of pressure as, for instance, a compressor. The perforated shield 102 allows a limited supply of air there-

through which passes between the hub 36a and the torque tube 42a. The portion 108 interconnecting the hub and rim of the wheel is solid to deflect the air passing through the perforated shield into a path which is formed by the radial outer edges of the rotor and stator members and the inner surface 58a of the rim 38 for the purpose of providing a protective blanket of cool air over the wheel rim 38a to protect the rim from the hot air which has passed between the rotor and stator members.

If a protective blanket of air over the wheel is not desired, the shield 82a may be solid and the portion 108 may be of the same spoke and window construction as in the previous embodiment.

From tests conducted, it has been found that the cooling embodiments disclosed herein are capable of cooling the brakes in about one-twentieth (1/20) the time of normal still air connection and in about one-fourth (1/4) to one-half (1/2) the time of a system utilizing a propeller vane for forcing air in an axial flow path past the brake elements.

WHAT WE CLAIM IS :—

1. A wheel and disc brake assembly for heavy duty service, e.g. for aircraft, comprising a plurality of stator members slidably mounted in an axial direction on a torque tube secured through a flange portion to the non-rotating axle of said wheel and defining an annular cavity with said axle, a plurality of rotor members alternating with said stator members and axially slidably mounted on said wheel, and actuating means adapted to squeeze said members together for braking of said wheel, said assembly further including a cooling device located in said annular cavity and adapted to supply air under pressure radially outwardly through openings provided in said torque tube to said stator and rotor members for cooling down the same regardless of the rotation of the wheel.

2. An assembly according to claim 1, wherein said cooling device comprises an annular impeller rotatably mounted on said axle and operated by an electric motor secured thereto, said impeller axially sucking in air through windows provided between the hub and the rim of said wheel.

3. An assembly according to claim 1, wherein said cooling device comprises at least one air inlet tube projecting through the flange portion of said torque tube and connected to an external source of air under pressure, said annular cavity being then bounded by a shield inserted between said axle and said torque tube.

4. An assembly according to claim 3, wherein said shield is perforated whereas the hub of the wheel is connected to the rim thereof by a solid portion, whereby a protective blanket of cool air is circulated over said rim.

5. An assembly according to any of the preceding claims, wherein heat shields are provided between the rim of the wheel and the outer edges of said stator and rotor members as well as between said members and the brake actuating means, both shields forming together a discharge annular duct for the hot air leaving the brake.

6. A wheel and disc brake assembly constructed, arranged and adapted to operate substantially as hereinabove described and as illustrated by Figure 1 of the accompanying drawings.

7. A wheel and disc brake assembly constructed, arranged and adapted to operate substantially as hereinabove described and as illustrated by Figure 2 of the accompanying drawings.

For the Applicants:
F. J. CLEVELAND & COMPANY,
Chartered Patent Agents,
Lincoln's Inn Chambers,
40-43, Chancery Lane,
London, W.C.2.

Berwick-upon-Tweed: Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd. — 1967
Published at the Patent Office, 25 Southampton Buildings, London, W.C.2 from which copies may be obtained.

1,091,693
2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

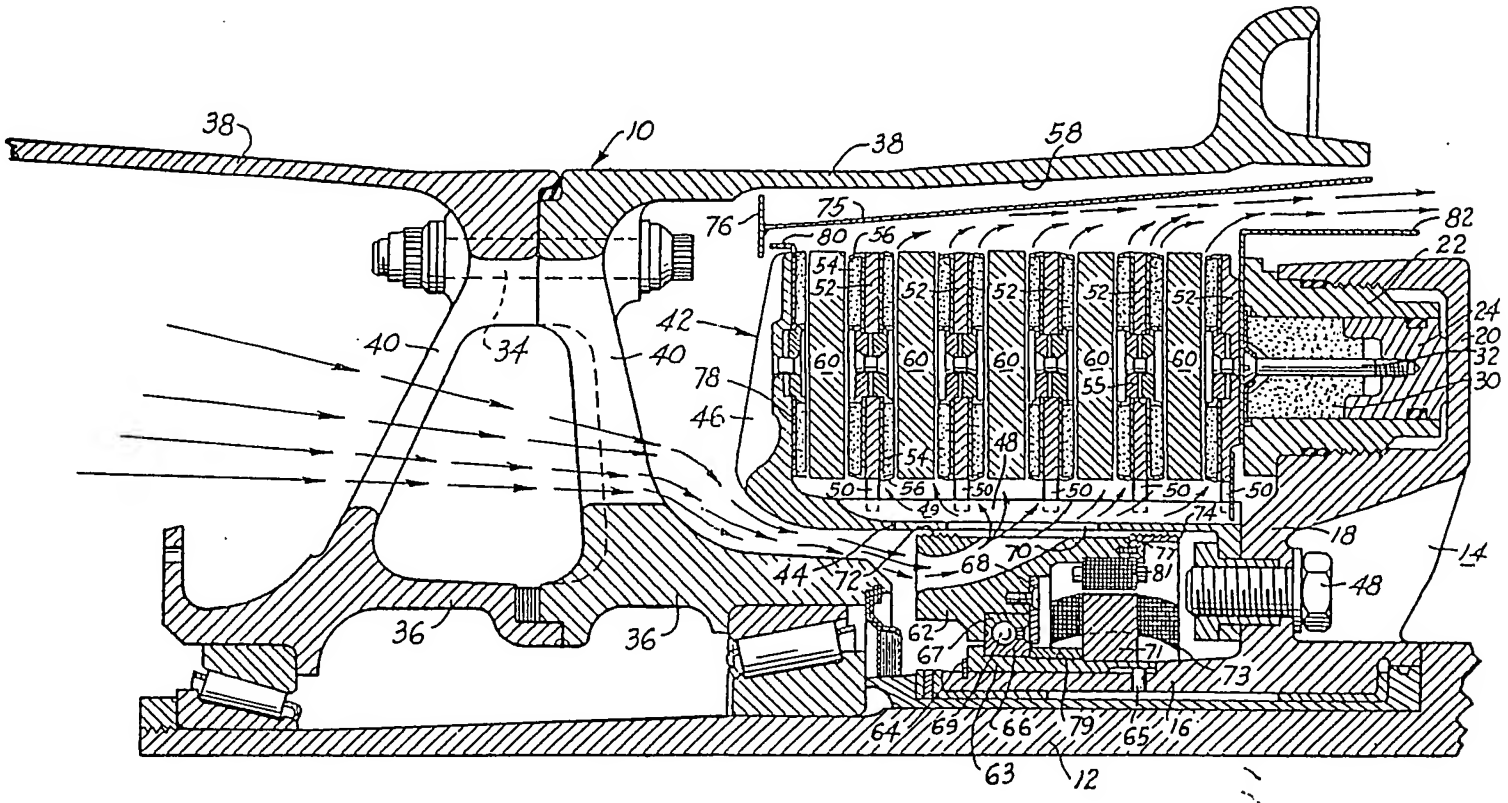

FIG. 1

℄ AXLE.

1,091,693
2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale
SHEET 2

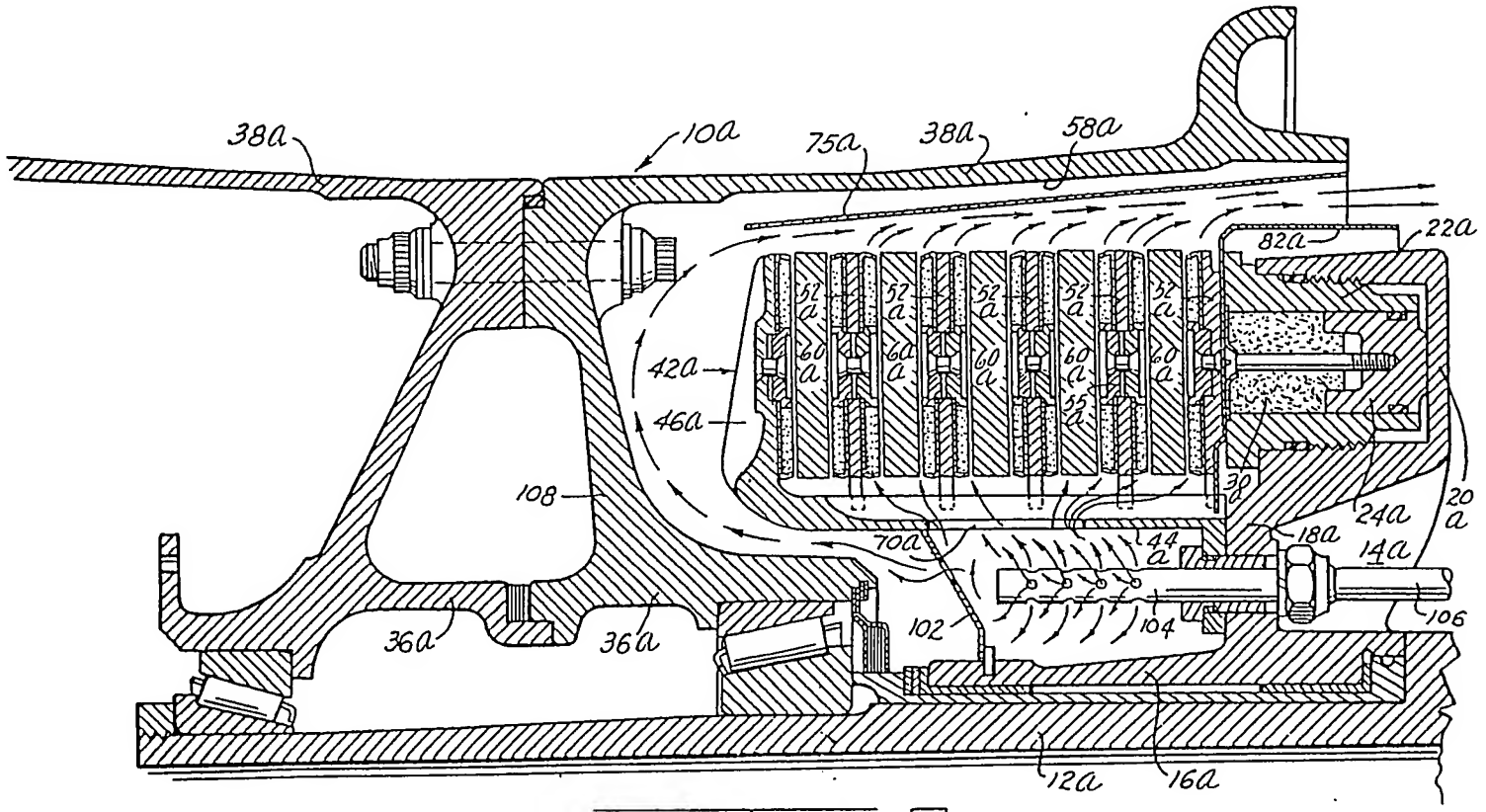

FIG. 2

℄ AXLE.